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The long-lived anthropogenic radionuclides I-129 and U-236 as tracers of water mass provenance, circulation timescales and mixing in the Arctic Ocean and Fram Strait

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Anthropogenic chemical tracers are powerful tools to study ocean circulation timescales, water mass provenance and mixing regimes. In the Arctic Ocean, the releases of artificial radionuclides from European nuclear reprocessing plants (RPs) act as valuable transient tracers as they label the inflowing Atlantic Waters with a distinct anthropogenic signal. In recent years, the combination of the two long-lived radionuclides ¹²⁹I and ²³⁶U has emerged as a new tracer pair and several studies have shown their potential to track pathways and timescales of Atlantic Water circulation in the Arctic Ocean and Fram Strait.

The circulation times of Atlantic-origin waters in the Arctic Ocean that were inferred using this tracer pair (in combination with the naturally occurring ²³⁸U) agree to those obtained by means of other transient tracers. Moreover, the combination of ¹²⁹I and ²³⁶U promises to be a useful marker of water mass mixing regimes both in the surface waters and the subsurface Atlantic layer. In particular, the interface between Atlantic and Pacific Waters in the polar surface layer of the Arctic Ocean can be easily identified as these two water masses are labelled by very different ¹²⁹I/²³⁶U and ²³⁶U/²³⁸U atom ratios.

Here we present a compilation of ¹²⁹I and ²³⁶U in a quasi-synoptic pan-arctic section including the Fram Strait and we show how this data can be used to gain information about circulation patterns. We discuss timescales and transport characteristics of Atlantic Water flow, the position and variability of the front between Atlantic and Pacific Waters and the temporal variability of Pacific Waters in the Fram Strait.